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Wimmer

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(54) **FIBER OPTIC CABLE ASSEMBLIES AND CONNECTOR ASSEMBLIES HAVING A CRIMP RING AND CRIMP BODY AND METHODS OF FABRICATING THE SAME**

(71) Applicant: **Corning Research & Development Corporation**, Corning, NY (US)

(72) Inventor: **Michael Wimmer**, Berlin (DE)

(73) Assignee: **Corning Research & Development Corporation**, Corning, NY (US)

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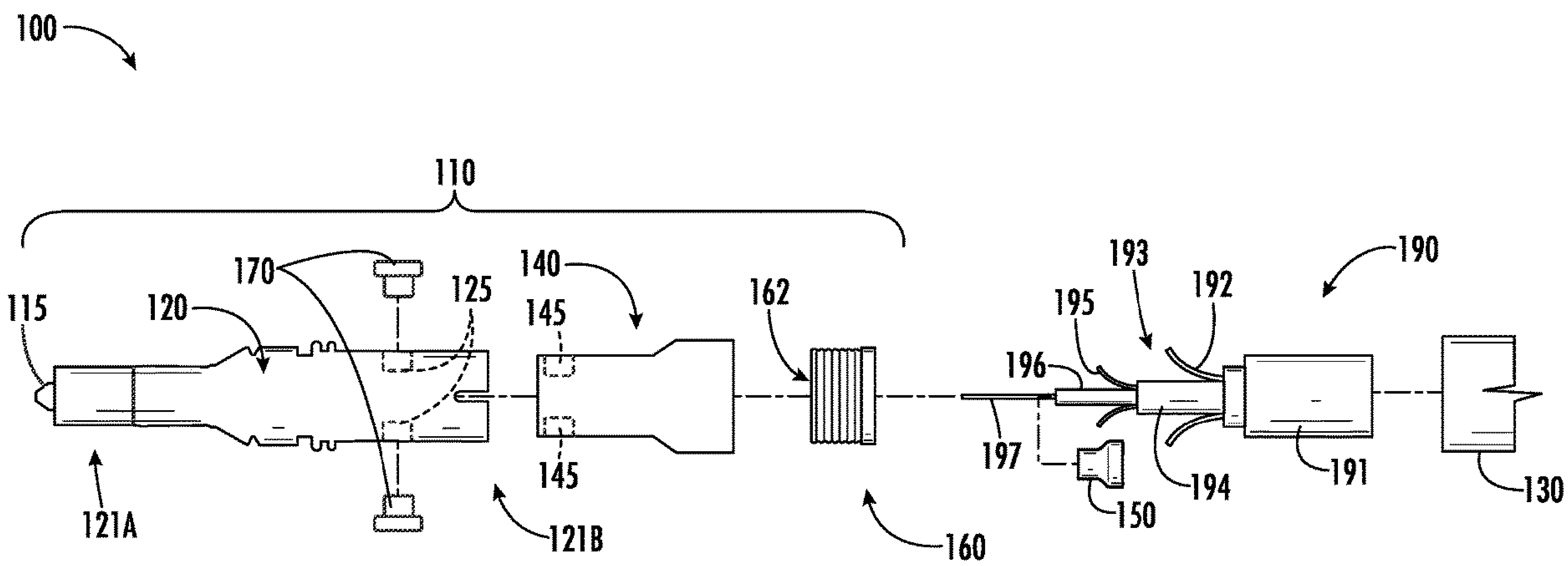
Primary Examiner — Sung H Pak
(74) *Attorney, Agent, or Firm* — Michael E. Carroll, Jr.

(57) **ABSTRACT**

Fiber optic cable assemblies and methods of fabrication are disclosed. In one embodiment, a fiber optic cable assembly includes a fiber optic cable and a connector assembly. The connector assembly includes a connector body having a body passageway and a body aperture. The connector assembly further includes a crimp ring, a crimp body and a locking element. The crimp ring includes a first end, a second end, a crimp ring passageway, and a crimp ring aperture. The crimp body includes a crimp body passageway and one or more crimp features. The crimp body is crimped to the cable jacket such that the strength members wrap around the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body. The locking element is disposed within the body aperture and the crimp ring aperture.

27 Claims, 4 Drawing Sheets



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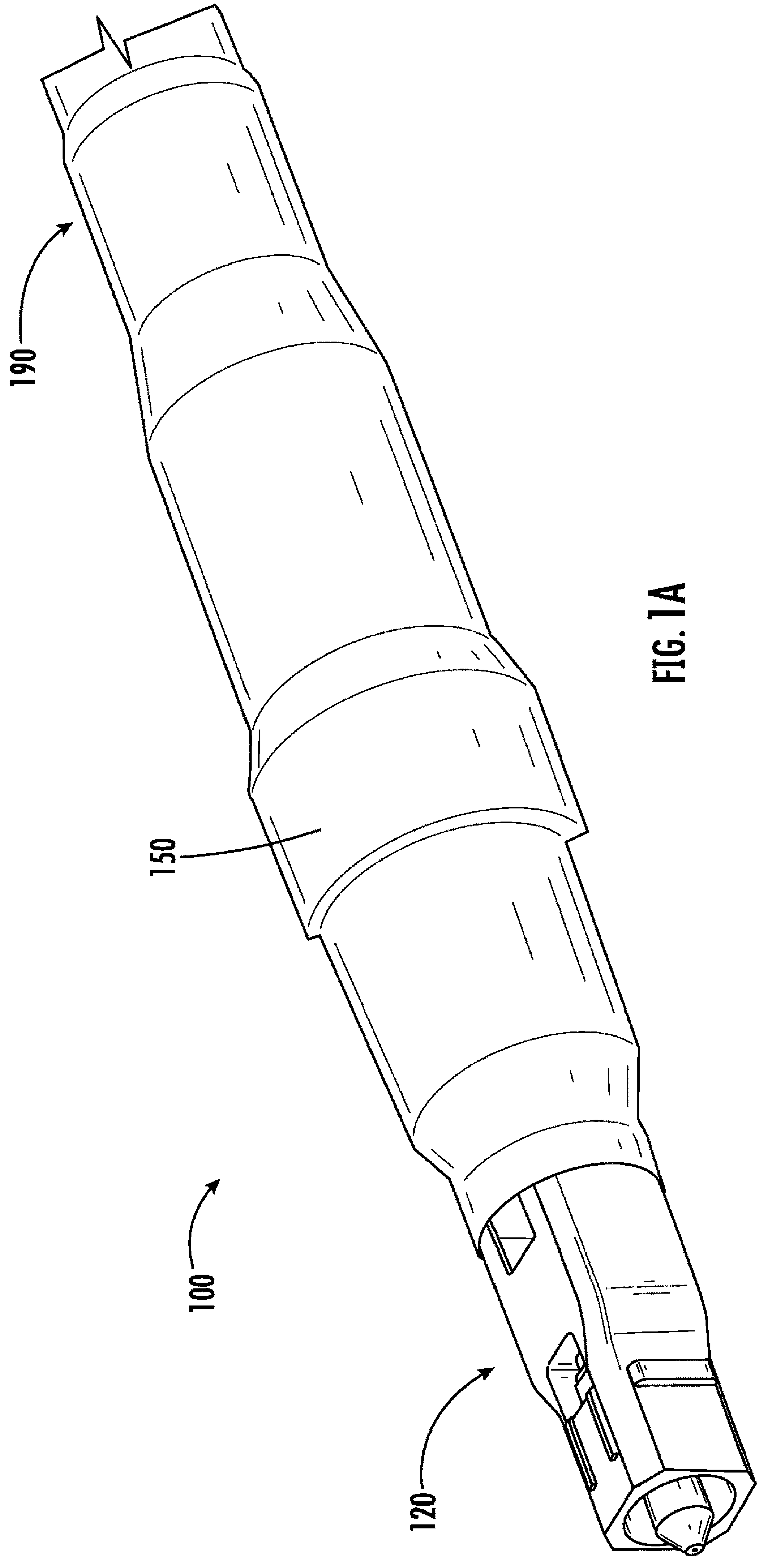
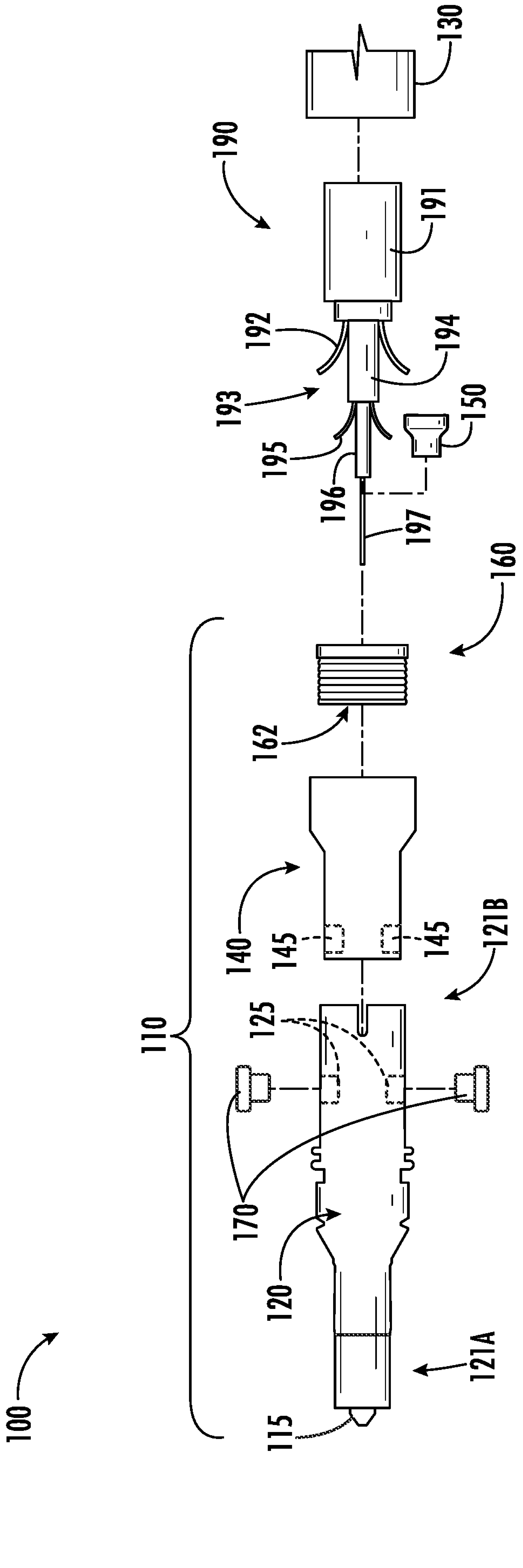


FIG. 1A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121B
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125
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121A
100
115

FIG. 1B

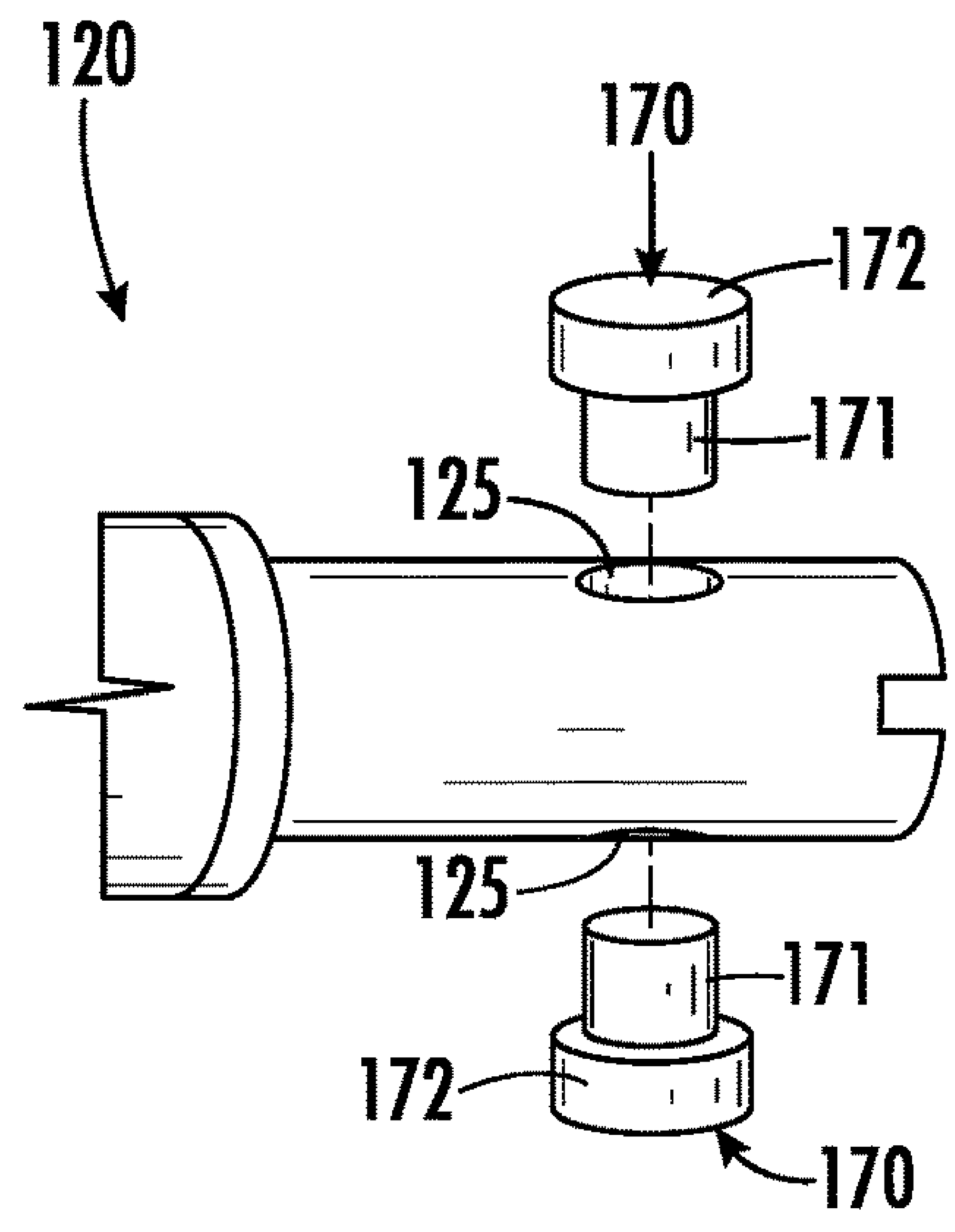

FIG. 2

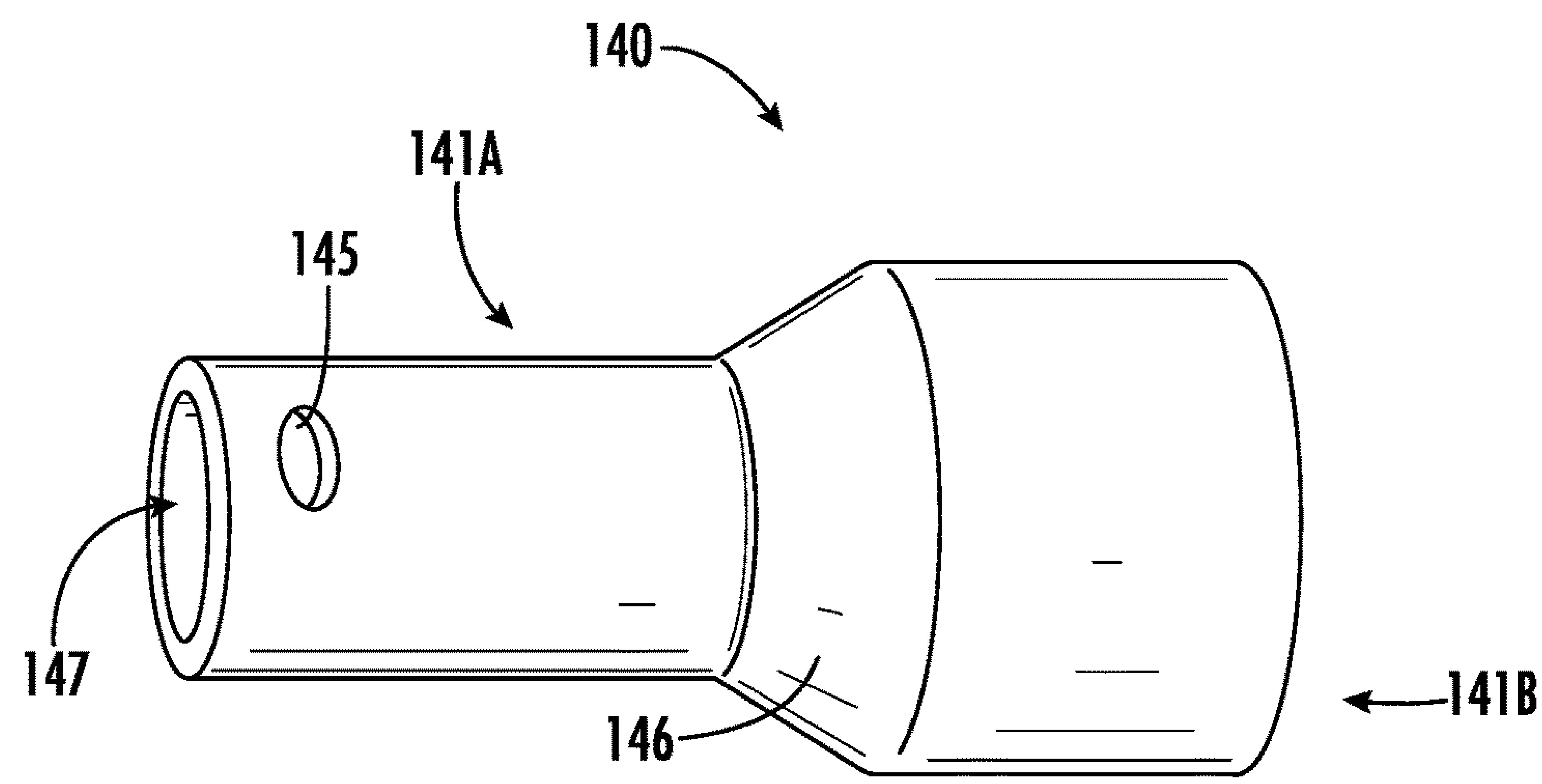

FIG. 3

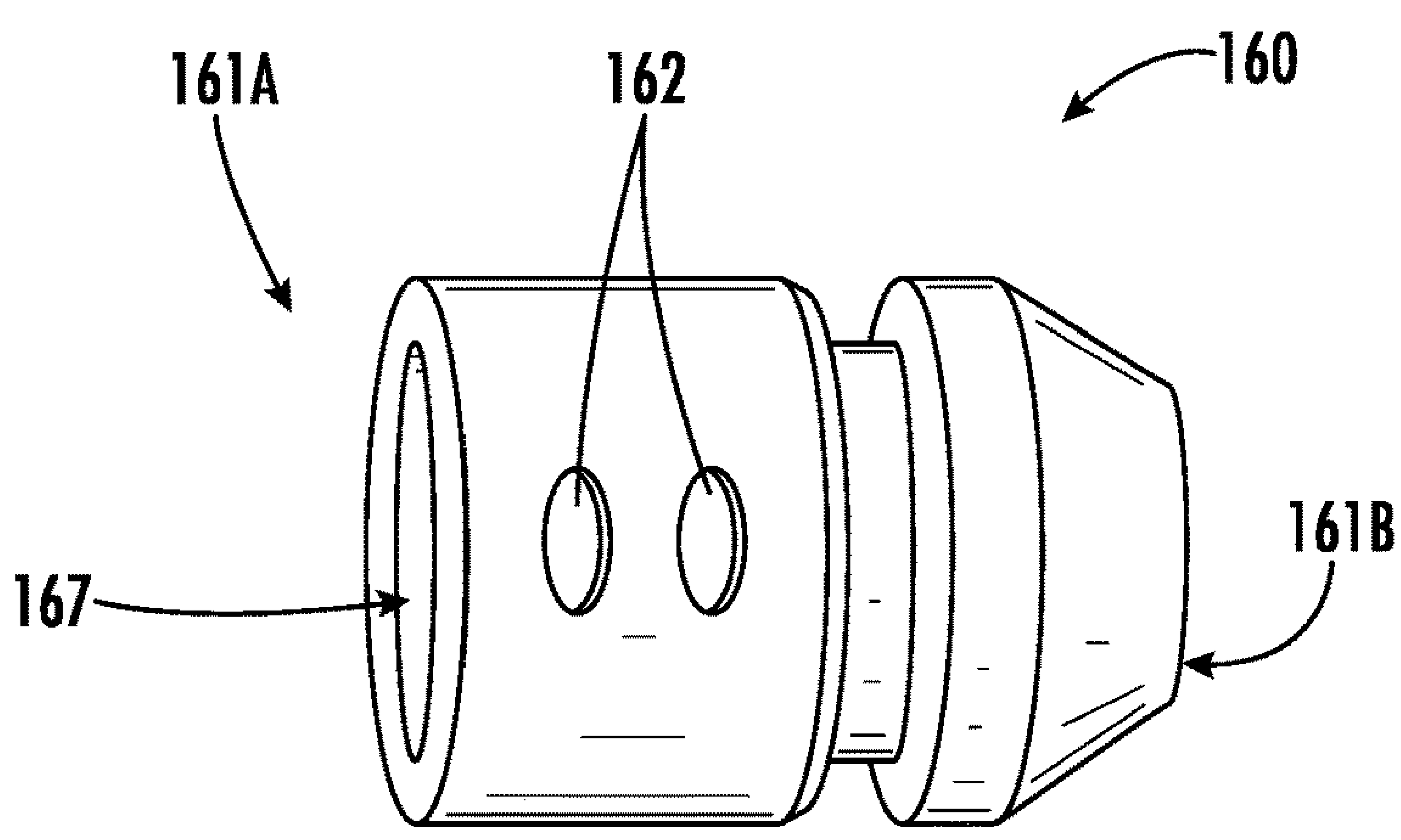

FIG. 4

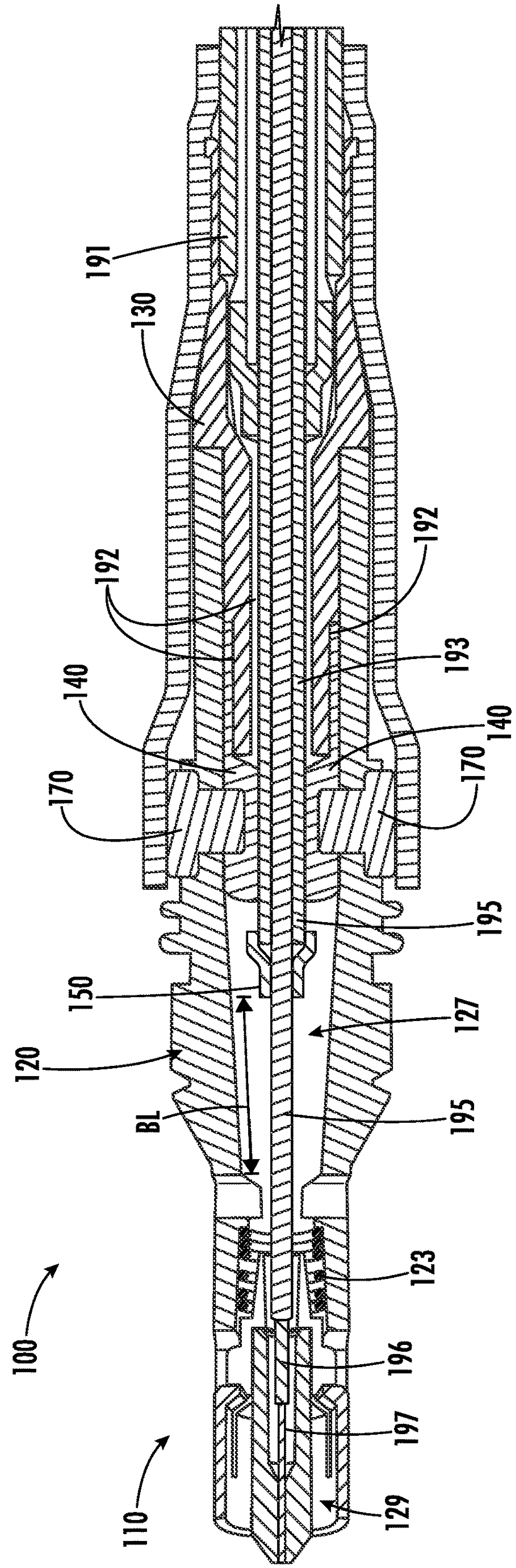
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FIG. 5

FIBER OPTIC CABLE ASSEMBLIES AND CONNECTOR ASSEMBLIES HAVING A CRIMP RING AND CRIMP BODY AND METHODS OF FABRICATING THE SAME

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims the benefit of priority of U.S. Provisional Application Ser. No. 63/119,060 filed on Nov. 30, 2020, the content of which is relied upon and incorporated herein by reference in its entirety.

FIELD

The disclosure is directed to fiber optic connectors and fiber optic cable assemblies and, more particularly, fiber optic connectors and fiber optic cable assemblies having a crimp ring and a crimp body to secure a fiber optic connector to a fiber optic cable.

BACKGROUND

Optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. As bandwidth demands increase, optical fiber is migrating deeper into communication networks such as in fiber to the premises applications such as FTTx, 5G and the like. As optical fiber extends deeper into communication networks there exist a need for building more complex and flexible fiber optic networks using fiber optic connectors in a quick and easy manner.

Fiber optic connectors were developed for making plug and play optical connections at links or devices in the communication network such as terminals, cabinets, patch panels, and like. The fiber optic connectors allow the distribution of optical signals within an optical network and provide the flexibility of locating the devices in convenient locations for efficient network design and deployment and also deferring connectivity and the associated expense until needed in the communication network.

Outdoor fiber optic cable assemblies, such as those including dual drop fiber cables, have a hardened connector on at least one end of the fiber optic cable. The hardened connector should be securely attached to the fiber optic cable in a manner that provides reliable sealing and strain relief. However, in some cases it may be desired to attached a certain type of hardened connector to a fiber optic cable that was not designed to be attached to certain hardened connector.

Consequently, there exists an unresolved need for fiber optic connector designs that enable hardened connectors to be securely attached to fiber optic cables.

SUMMARY

The disclosure is directed to connector assemblies and fiber optic cable assemblies. The embodiments described herein are directed to connector assemblies and fiber optic cable assemblies including a crimp ring and a crimp body to securely attach the connector assembly to a fiber optic cable. Embodiments may be utilized to attach a connector to a type of fiber optic cable that it was not designed to be attached to. More particularly, strength members of the fiber optic cable are pulled back over a crimp body that is disposed on the cable jacket of the fiber optic cable. A crimp ring is then crimped over the strength members and the crimp body to secure the crimp ring to the strength members and the crimp body. At least one locking element is used to secure a connector body of the connector to the crimp ring. Heat shrink elements are used to provide sealing.

One aspect of the disclosure is directed to a fiber optic cable assembly including a fiber optic cable and a connector assembly. The fiber optic cable has an optical fiber, strength members and a cable jacket. The connector assembly includes a connector body having a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The connector assembly further includes a crimp ring, a crimp body and at least one locking element. The crimp ring includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end has a smaller diameter than the second end. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway. The crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end of the crimp ring is disposed within the body passageway. The at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

Another aspect of the disclosure is directed to including a dual drop fiber optic cable and a connector assembly. The dual drop fiber optic cable has an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members. The connector assembly includes a connector body having a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The connector assembly further includes a crimp ring, a crimp body, at least one locking element, a first heat shrink element, and a second heat shrink element. The crimp ring includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end has a smaller diameter than the second end. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway. The crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end of the crimp ring is disposed within the body passageway and the sub-unit is disposed within the crimp ring passageway. The at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body. The first heat shrink element is disposed about the connector body, the second end of the crimp ring, and the cable jacket. The second heat shrink element surrounds a tight buffer surrounding the optical fiber that is within the sub-unit and an sub-unit jacket of the sub-unit.

Yet another aspect of the disclosure is directed to a connector assembly including a connector body, a crimp ring, a crimp body, and at least one locking element. The connector body includes a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end. The crimp ring includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end of the crimp ring has a smaller diameter than the second end. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features. The first end of the crimp ring is disposed within the body passageway. The at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

Yet another aspect of the disclosure is directed to a method of fabricating a fiber optic cable assembly. The method includes preparing a dual drop fiber optic cable having an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members. The sub-unit includes a tight buffer surrounding the optical fiber, inner strength members surrounding the tight buffer, and a sub-unit jacket surrounding the inner strength members. The method further includes disposing a first heat shrink element on the cable jacket, disposing a second heat shrink element on a portion of the sub-unit jacket and a portion of the tight buffer and a providing heat to the second heat shrink element, and disposing a crimp body on the cable jacket. The crimp body includes a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features. The method further includes pulling back at least a portion of the strength members so that they are adjacent the crimp body, and disposing a crimp ring on the crimp body. The crimp body includes a first end, a second end, a crimp ring passageway extending from the first end to the second end, a tapered section between the first end and the second end, and at least one crimp ring aperture at the second end. The first end has of the crimp ring a smaller diameter than the second end of the crimp ring. The sub-unit is disposed within crimp ring passageway at the first end and the crimp body is disposed within the crimp ring passageway at the second end. The method also includes applying a crimping force to crimp the crimp ring to the crimp body at the one or more crimp features, and inserting the dual drop fiber optic cable and the crimp ring into a body passageway of a connector body. The connector body includes a first end, a second end, the body passageway extending from the first end to the second end, and at least one body aperture at the second end. The method also includes aligning the at least one body aperture of the connector body with the at least one crimp ring aperture of the crimp ring, and inserting at least one locking element into the at least one body aperture of the connector body and the at least one crimp ring aperture of the crimp ring to secure the connector body to the crimp ring. The method further includes applying heat to the first heat shrink element to secure the connector body and the crimp ring to the fiber optic cable.

Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the same as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments that are intended to provide an overview or framework for understanding the nature and character of the claims. The accompanying drawings are included to provide a further understanding of the disclosure, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments and together with the description serve to explain the principles and operation.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1**A is a perspective view of an example fiber optic cable assembly according to one or more embodiments described and illustrated herein;

FIG. **1**B is an exploded view of the example fiber optic cable assembly according to one or more embodiments described and illustrated herein;

FIG. **2** is a perspective view of an example connector body and two locking elements according to one or more embodiments described and illustrated herein;

FIG. **3** is a perspective view of an example crimp ring according to one or more embodiments described and illustrated herein;

FIG. **4** is a perspective view of an example crimp body according to one or more embodiments described and illustrated herein; and

FIG. **5** is a cross section view of an example fiber optic cable assembly according to one or more embodiments described and illustrated herein.

DETAILED DESCRIPTION

Reference will now be made in detail to the embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, like reference numbers will be used to refer to like components or parts.

The concepts disclosed herein are related to connector assemblies and fiber optic cable assemblies including a crimp ring and a crimp body to securely attach the connector assembly to a fiber optic cable. Embodiments may be utilized to attach a connector assembly to a type of fiber optic cable that it was not designed to be attached to. As a non-limiting example, the connector may be a Evolv hardened optical connector sold by Corning Optical Communications of Hickory, N.C., and the fiber optic cable may be a dual drop fiber optic cable having a sub-unit surrounded by strength members and a cable jacket.

More particularly, strength members of the fiber optic cable are pulled back over a crimp body that is disposed on the cable jacket of the fiber optic cable. A crimp ring is then crimped over the strength members and the crimp body to secure the crimp ring to the strength members and the crimp body. At least one locking element is used to secure a connector body of the connector to the crimp ring. Heat shrink elements are used to provide environmental sealing.

Various embodiments of connectors, fiber optic cable assemblies, and methods of fabricating the same are described in detail below.

FIGS. **1**A and **1**B depict an example fiber optic cable assembly **100** comprising a connector assembly **110** coupled to an end of a fiber optic cable **190**. FIG. **1**A illustrates the fiber optic cable assembly **100** in an assembled state while FIG. **1**B is an exploded view of the fiber optic cable assembly **100**. The connector assembly **110** generally comprises, among other components, a connector body **120**, a crimp ring **140**, a crimp body **160**, a first heat shrink element **130**, and a second heat shrink element.

In the illustrated embodiment, the fiber optic cable **190** comprises a dual drop fiber optic cable. Referring to FIG. **1**B, the fiber optic cable **190** is illustrated as a prepared dual drop fiber optic cable that is ready to receive the fiber optic connector **110**. That is, various layers of the fiber optic cable **190** have been stripped to receive the connector assembly **110**. The example fiber optic cable **190** includes a cable jacket **191**, strength members **192**, and a sub-unit **193**. The sub-unit **193** comprises a sub-unit jacket **194**, inner strength members **195**, a tight buffer **196**, and an optical fiber **197**.

The optical fiber **197** may include a core and a cladding to guide light by total internal reflection. The core and cladding are not illustrated in FIG. **1**B, but together define the optical fiber **197** and may comprise glass (e.g., germanium-doped silica). The tight buffer **196** surrounds the optical fiber **197** to protect the optical fiber **197** from the environment and mechanical loads. As a non-limiting example, the tight buffer **196** may comprise a primary coating, and a secondary coating that surrounds the primary coating. The primary coating may be an acrylic polymer or the like. The secondary coating may comprise polyvinyl chloride (PVC), polyurethane, polyolefin, or the like.

The inner strength members **195** are disposed around the tight buffer **196** to provide mechanical strength to the fiber optic cable **190**. The inner strength members **195** may be any suitable type of material, such as rigid glass-reinforced plastic (GRPs) or tensile yarns such as aramid, fiberglass, Kevlar® or the like that are flexible and provide tensile strength. Surrounding the inner strength members **195** is a sub-unit jacket **194**. The material of the sub-unit jacket **194** may include, but is not limited to, polyvinyl chloride (PVC), polyethylene (PE), a UV curable resin (e.g. acrylate), or a fluoro-compound.

Strength members **192** are disposed around the sub-unit **193** to provide additional mechanical strength to the fiber optic cable **190**. The inner strength members **195** may be any suitable type of material, such as GRPs or flexible yarns such as aramid, fiberglass, Kevlar® or the like. The cable jacket **191** surround the strength members **192**. Non-limiting materials for the cable jacket **111** include PVC, polyethylene PE, a UV curable resin (e.g. acrylate), or a fluoro-compound.

The connector body **120** may take on any configuration. In the embodiment shown by FIGS. **1**A and **1**B, the connector body **120** is configured as a hardened SC connector with a defined single fiber connection interface. The connector body **120** generally comprises a first end **121**A, a second end **121**B and a body passageway **127** (FIG. **5**) between the first end **121**A and the second end **121**B. The second end **121**B of the connector body **120** includes at least one body aperture **125** that extends through the connector body **120** to the body passageway **127**. The at least one body aperture **125** is sized for receiving at least one locking element **170** for securing the connector body **120** to the crimp ring **140**, the crimp body **160** and the fiber optic cable **190**, as described in more detail below. FIG. **2** is a partial view of an example second end **121**B of a connector body **120** having two body apertures **125** for receiving two locking elements **170**. The at least one body aperture **125** may be formed by drilling one or more holes through the second end **121**B, for example. As a non-limiting example, the locking elements **170** may be configured as locking buttons having an insertion portion **171** extending from a flange portion **172**. The locking element **170** may have a symmetric or asymmetric design. However, it should be understood that the at least one locking element **170** may take on other configurations.

FIG. **3** illustrates an example crimp ring **140** as is shown in FIG. **1**B. The crimp ring has a first end **141**A, a second end **141**B, a taper portion **146** between the first end **141**A and the second end **141**B, and a crimp ring passageway **147**. The diameter of the first end **141**A is smaller than the diameter of the second end **141**B, and the diameter of the taper portion **146** increases in a direction from the first end **141**A to the second end **141**B. The crimp ring **140** further includes at least one crimp ring aperture **145** at the second end **141**B. The at least one crimp ring aperture **145** is sized to also receive the at least one locking element **170** as described above with respect to the body aperture **125**.

The crimp ring **140** is fabricated from a deformable material that can be crimped around the crimp body **160** as described below. As a non-limiting example, the crimp ring **140** may be made of a metal material.

FIG. **4** illustrates an example crimp body **160** as is shown in FIG. **1**B. The crimp body **160** has a first end **161**A, a second end **161**B, and a crimp body passageway **167** between the first end **161**A and the second end **161**B. The crimp body **160** is configured to provide a rigid surface onto which the crimp ring **140** is crimped. In some embodiments, the outer surface of the first end **161**A of the crimp body **160** includes one or more crimp features **162** to receive the second end **141**B of the crimp ring **140** and improve the rigid coupling between the crimp ring **140** and the crimp body **160**. The crimp features **162** may be indentations or piercings that are formed in the crimp body **160**. The crimp features **162** may take on any geometry, such as circles, ovals, lines, and the like.

The first heat shrink element **130** and the second heat shrink **150** element may be made of any material capable of shrinking in size upon the application of heat. A non-limiting heat shrink material includes polyolefin. As described in more detail below, the first heat shrink element **130** provides sealing from the environment and also assists in securing the connector **110** to the fiber optic cable **190**.

The at least one locking element **170**, the crimp ring **140**, the crimp body **160**, and the first heat shrink element **130** cooperate to secure the connector **110** to the fiber optic cable **190**. FIG. **5** illustrates a cross section view of an example connector **110** coupled to an example fiber optic cable **190**. The fiber optic cable **190** is prepared such that a portion of the cable jacket **191** is stripped away to expose the sub-unit **193** and the strength members **192**. The strength members **192** are trimmed such that at least some of them are pulled back in a direction away from the end of the fiber optic cable **190** receiving the connector **110**.

The fiber optic cable is disposed through the crimp body passageway **167** of the crimp body **160** such that the crimp body **160** contacts the cable jacket **191**. In some embodiments, an end face of the cable jacket **191** abuts an inner shoulder **168** of the crimp body **160** such that the inner shoulder **168** acts as a stop for the cable jacket **191**. The strength members **192** are pulled back such that they are disposed on the outer surface of the crimp body **160** and contact the crimp features **162**.

The crimp ring **140** is disposed on the fiber optic cable **190** such that the exposed sub-unit **193** is within the crimp ring passageway **147** at the first end **141**A, and the crimp body **160** is disposed within the crimp ring passageway **147** at the second end **141**B. The second end **141**B of the crimp ring **140** is crimped to the crimp body **160** such that the strength members **192** are between the crimp body **160** and the crimp ring **140**, and within the crimp features **162** of the crimp body **160**. The crimp ring **140** may be crimped to the strength members **192** and the crimp body **160** by a crimping tool, for example. Thus, the crimp ring **140** and the crimp body **160** are secured to the fiber optic cable **190** by way of the strength members **192**.

In some embodiments, the second heat shrink element **150** is disposed around the interface of the tight buffer **196** and the sub-unit jacket **194** to secure the sub-unit strength members that are between the sub-unit jacket **194** and the tight buffer **196**. Heat is applied to the second heat shrink element **150** to shrink it to the tight buffer **196** and the sub-unit jacket **194**.

The first end **161**A of the crimp ring **140** is disposed within body passageway **127** such that the at least one crimp ring aperture **145** of the crimp ring **140** with the at least one body aperture **125** of the connector body **120**. The connector body **120** is secured to the crimp ring **140** (and thus the crimp body **160** and the fiber optic cable **190**) by the at least one locking element **170** disposed within the at least one body aperture **125** and the at least one crimp ring aperture **145**. The at least one body aperture **125**, the at least one crimp ring aperture **145** and the at least one locking element **170** may be configured so that the at least one locking element **170** is non-removable from the at least one body aperture **125** and the at least one crimp ring aperture **145**. For example, the components may mate by a non-removable press fit. In other embodiments, the at least one locking element **170** is removable from the at least one body aperture **125** and the at least one crimp ring aperture **145**.

Still referring to FIG. **5**, the first heat shrink element **130** is securely disposed over the second end **121**B of the connector body **120**, the second end **141**B of the crimp ring **140**, and a portion of the cable jacket **191**. The first heat shrink element **130** may assist in maintaining the at least one locking element **170** in the at least one body aperture **125** and the at least one crimp ring aperture **145**.

The optical fiber within the tight buffer **196** is within the body passageway **127**. The body passageway **127** may be sized such that the tight buffer **196** portion of the fiber optic cable **190** may buckle along a buckle length BL. A ferrule assembly **129** is also disposed within the body passageway **127**, and is biased by a spring element **123**. The tight buffer **196** is stripped away at the very end of the fiber optic cable **190** to expose the optical fiber **197** (not shown in FIG. **5**). The optical fiber **197** is inserted into, and maintained by, the ferrule assembly **129**.

Thus, the connector **110** is secured to the fiber optic cable **190**. Still referring to FIG. **5**, one side of the insertion portion **171** of the at least one locking element **170** is used for transferring pull force and the other side is designed to deform during the press-fit to overcome tolerances. One locking element **170** may be used; however, at least two locking elements **170** may spread the load distribution more evenly into the connector body **120**. Furthermore, the assembly process can be designed to press the locking element contrary on one axis to each other. The correct orientation of the locking elements may be provided by jigs and figures, for example.

For cable pull force transfer, the locking element **170** is designed in relation with the connector body **120** to resist the maximum load before deforming. Due to the adhesive of the first heat sink element **130**, the entire assembly becomes locked down at the connector end.

The crimp ring **140** is designed to grab the strength members **192** at its position on the fiber optic cable **190**. Pull forces on the strength members **192** are directed from the fiber optic cable **190** without any freedom of movement for the strength members **192** (e.g., slack).

Strain relief is provided by compression of the cable jacket **191**, which compresses the strength members **192**. In some embodiments, only the tensile yarns such the Kevlar® of the strength members **192** is disposed between the crimp ring **140** and the crimp body **160**. Thus, the glass yarn is cut short and not folded back. This may be done for space constrains. However, in some embodiments the glass yarn is folded back.

To resist cable bending, the complete cable end is inserted and supported in the connector **110**. This reduces the stain relief length and minimizes connector length. This design reduces the generated moment on the connector body interface during a side pull of the fiber optic cable, and causes higher reliability.

To resist cable torsion, the crimp body is compressed with cable jacket **191**, as well as the first heat shrink element **130**. The two notches at the connector body **120** interact with the crimp body torsion wings. To resist pull load, several mechanism work together to demarcate the fiber optic cable components relative to each other. The main pull force will be transferred by the strength members **192** through the crimp body **160**. The at least one locking element **170** is designed to transfer the load from the crimp body **160** into the connector body **120**. To strengthen the strength member crimp, a metal to metal crimp connection is designed by fabricating both the crimp ring **140** and the crimp body **160** from metal. As a non-limiting example, the crimp ring **140** and the crimp body **160** may be fabricated from an aluminum alloy. To avoid strength member slippage, the crimp ring **140** is locked on the crimp body **160**. The bigger wall thickness of the front of the crimp body front causes the locking after crimping, due to the bigger outer radius of the crimp body **160**. Further, the crimp features create further locking forces between the crimp ring **140** and the crimp body **160**.

The first heat shrink element **130** supports pull force transfer on the cable jacket **191** in the connector body **120**. The crimp body **160** grabs the cable jacket **191** and strain relieves it. To resist cable press-in force during installation, the design transfers the load from the jacket into the connector body. Sealing is provided by the first heat element **130**. The adhesive inside the first heat shrink element **130** bond the cable jacket **191** and the connector body **120** to seal off any potential leak paths.

Embodiments are also directed to methods of fabricating a fiber optic cable assembly. Referring generally to FIGS. **1**B and **5**, the method first includes preparing a dual drop fiber optic cable. Preparing the dual drop fiber optic cable includes stripping a portion of the cable jacket **191** to expose strength members **192** and the sub-unit **193**, trimming a portion of the strength members **192**, stripping a portion of the sub-unit jacket **194** and the inner strength members **195** to expose the tight buffer **196**, and stripping a portion of the tight buffer **196** to expose the optical fiber **197**.

Next, the first heat shrink is disposed on the cable jacket **191**, and the second heat shrink element **150** is disposed on a portion of the sub-unit jacket **194** and a portion of the tight buffer **196**. Heat is applied to the second heat shrink element **150** to secure the inner strength members **195**. The crimp body **160** is disposed on the cable jacket **191**. The method further includes pulling back at least a portion of the strength members **192** so that they are adjacent the crimp body **160**.

Next, the crimp ring **140** is disposed on the crimp body **160** such that the first end **161**A of the crimp ring **140** surrounds the sub-unit **193**. The method includes applying a crimping force to crimp the crimp ring **140** to the crimp body **160** at the one or more crimp features **162**, which locks the strength members **192** in between the crimp ring **140** and the crimp body **160**. Then, the method includes inserting the dual drop fiber optic cable **190** and the crimp ring **140** into a body passageway **127** of a connector body **120**. The at least one body aperture **125** of the connector body **120** is aligned with the at least one crimp ring aperture **145** of the crimp ring **140**. The at least one locking element **170** is inserted into the at least one body aperture **125** of the connector body **120** and the at least one crimp ring aperture **145** of the crimp ring **140** to secure the connector body **120** to the crimp ring **140**. Then, heat is applied to the first heat shrink element **130** to secure the connector body **120** and the crimp ring **140** to the fiber optic cable **190**.

It should now be understood that embodiments of the present disclosure are directed to fiber optic cable assemblies having a connector assembly securely attached to a fiber optic cable assembly by use of a crimp ring and a crimp body. The strength members of the fiber optic cable are crimped between the crimp ring and the crimp body. Thus, the strength members are utilized to secure the crimp ring and the crimp body to the fiber optic cable. Additionally, at least one locking element is used to lock a connector body of the connector to the crimp ring, and a heat shrink element is used to provide sealing and strain relief functions.

Although the disclosure has been illustrated and described herein with reference to explanatory embodiments and specific examples thereof, it will be readily apparent to those of ordinary skill in the art that other embodiments and examples can perform similar functions and/or achieve like results. All such equivalent embodiments and examples are within the spirit and scope of the disclosure and are intended to be covered by the appended claims. It will also be apparent to those skilled in the art that various modifications and variations can be made to the concepts disclosed without departing from the spirit and scope of the same. Thus, it is intended that the present application cover the modifications and variations provided they come within the scope of the appended claims and their equivalents.

The invention claimed is:

1. A fiber optic cable assembly comprising:

a fiber optic cable comprising an optical fiber, strength members and a cable jacket; and

a connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features; and

at least one locking element;

wherein:

the fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway;

the crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket;

the second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

the first end of the crimp ring is disposed within the body passageway; and

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

2. The fiber optic cable assembly of claim **1**, further comprising a first heat shrink element disposed about the connector body, the second end of the crimp ring, and the cable jacket.

3. The fiber optic cable assembly of claim **2**, wherein the fiber optic cable further comprises a sub-unit that maintains the optical fiber and is surrounded by the strength members.

4. The fiber optic cable assembly of claim **3**, further comprising a second heat shrink surrounding a tight buffer surrounding the optical fiber that is within the sub-unit and a sub-unit jacket of the sub-unit.

5. The fiber optic cable assembly of claim **1**, wherein the one or more crimp features are one or more indentations in the crimp body.

6. The fiber optic cable assembly of claim **1**, wherein the body passageway comprises a buckle cavity.

7. The fiber optic cable assembly of claim **1**, wherein the at least one locking element comprise at least one locking button comprising an insertion portion and a flange portion.

8. The fiber optic cable assembly of claim **1**, wherein the strength members comprises glass yarn and tensile yarn.

9. The fiber optic cable assembly of claim **1**, further comprising a ferrule assembly disposed within the body passageway.

10. The fiber optic cable assembly of claim **1**, wherein:

the at least one body aperture comprises a first body aperture and a second body aperture;

the at least one crimp ring aperture comprises a first crimp ring aperture and a second crimp ring aperture; and

the at least one locking element comprises a first locking element and a second locking element.

11. A fiber optic cable assembly comprising:

a dual drop fiber optic cable comprising an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members;

a connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features;

at least one locking element;

a first heat shrink element; and

a second heat shrink element;

wherein:

the dual drop fiber optic cable is disposed within the crimp body passageway, the crimp ring passageway, and the body passageway;

the crimp body is crimped to the cable jacket such that the strength members wrap around an outer surface of the cable jacket and are disposed between the crimp body and the cable jacket;

the second end of the crimp ring is crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

the first end of the crimp ring is disposed within the body passageway and the sub-unit is disposed within the crimp ring passageway;

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body;

the first heat shrink element disposed about the connector body, the second end of the crimp ring, and the cable jacket; and

the second heat shrink element surrounds a tight buffer surrounding the optical fiber that is within the sub-unit and a sub-unit jacket of the sub-unit.

12. The fiber optic cable assembly of claim **11**, wherein the one or more crimp features are one or more indentations in the crimp body.

13. The fiber optic cable assembly of claim **11**, wherein the body passageway comprises a buckle cavity.

14. The fiber optic cable assembly of claim **11**, wherein the at least one locking element comprise at least one locking button comprising an insertion portion and a flange portion.

15. The fiber optic cable assembly of claim **11**, wherein the strength members comprises glass yarn and tensile yarn.

16. The fiber optic cable assembly of claim **11**, further comprising a ferrule assembly disposed within the body passageway.

17. A connector assembly comprising:

a connector body comprising a first end, a second end, a body passageway extending from the first end to the second end, and at least one body aperture at the second end;

a crimp ring comprising a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end;

a crimp body comprising a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features; and

at least one locking element;

wherein:

the second end of the crimp ring is configured to be crimped to the crimp body such that at least a portion of the second end of the crimp ring is disposed within the one or more crimp features;

the first end of the crimp ring is disposed within the body passageway; and

the at least one locking element is disposed within the at least one body aperture and the at least one crimp ring aperture to secure the crimp ring to the connector body.

18. The connector assembly of claim **17**, wherein the one or more crimp features are one or more indentations in the crimp body.

19. The connector assembly of claim **17**, wherein the body passageway comprises a buckle cavity.

20. The connector assembly of claim **17**, wherein the at least one locking element comprises at least one locking button comprising an insertion portion and a flange portion.

21. A method of fabricating a fiber optic cable assembly, the method comprising:

preparing a dual drop fiber optic cable comprising an optical fiber, a sub-unit, strength members surrounding the sub-unit, and a cable jacket surrounding the strength members, wherein the sub-unit comprises a tight buffer surrounding the optical fiber, inner strength members surrounding the tight buffer, and a sub-unit jacket surrounding the inner strength members;

disposing a first heat shrink element on the cable jacket;

disposing a second heat shrink element on a portion of the sub-unit jacket and a portion of the tight buffer, and a providing heat to the second heat shrink element;

disposing a crimp body on the cable jacket, wherein the crimp body comprises a first end, a second end, a crimp body passageway extending between the first end and the second end, and one or more crimp features;

pulling back at least a portion of the strength members so that they are adjacent the crimp body;

disposing a crimp ring on the crimp body, wherein:

the crimp body comprises a first end, a second end, a crimp ring passageway extending from the first end to the second end, and at least one crimp ring aperture at the second end, wherein the first end has a smaller diameter than the second end; and

the sub-unit is disposed within the crimp ring passageway at the first end and the crimp body is disposed within the crimp ring passageway at the second end;

applying a crimping force to crimp the crimp ring to the crimp body at the one or more crimp features;

inserting the dual drop fiber optic cable and the crimp ring into a body passageway of a connector body, wherein the connector body comprises a first end, a second end, the body passageway extending from the first end to the second end, and at least one body aperture at the second end;

aligning the at least one body aperture of the connector body with the at least one crimp ring aperture of the crimp ring;

inserting at least one locking element into the at least one body aperture of the connector body and the at least one crimp ring aperture of the crimp ring to secure the connector body to the crimp ring; and

applying heat to the first heat shrink element to secure the connector body and the crimp ring to the dual drop fiber optic cable.

22. The method of claim **21**, wherein preparing the dual drop fiber optic cable comprises:

stripping a portion of the cable jacket to expose strength members and the sub-unit;

trimming a portion of the strength members;

stripping a portion of the sub-unit jacket and the sub-unit strength members to expose the tight buffer; and stripping a portion of the tight buffer to expose the optical fiber.

23. The method of claim **21**, wherein the one or more crimp features are one or more indentations in the crimp body.

24. The method of claim **21**, wherein the body passageway comprises a buckle cavity.

25. The method of claim **21**, wherein the at least one locking element comprises at least one locking button comprising an insertion portion and a flange portion.

26. The method of claim **21**, wherein the strength members comprises glass yarn and tensile yarn.

27. The method of claim **21**, further comprising inserting the optical fiber into a ferrule assembly disposed within the body passageway.

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